Nature Conservation 47: 15–33 (2022)
doi: 10.3897/natureconservation.47.70732
https://natureconservation.pensoft.net

REVIEW ARTICLE

A peer-reviewed open-access journal
Nature Conservation
Launched to accelerate biodiversity conservation

Germany's federal waterways – A linear infrastructure network for nature and transport

Volker Steege[1], Dirk Engelbart[1], Nicole T. Hädicke[1], Kai Schäfer[1], Jennifer K. Wey[1]

1 *Federal Ministry of Transport and Digital Infrastructure, Division WS 14 „Climate Change, Environmental Protection, Hydrology, Federal Institute of Hydrology", Robert-Schuman-Platz 1, D-53175 Bonn, Germany*

Corresponding author: Volker Steege (volker.steege@bmvi.bund.de)

Academic editor: Manisha Bhardwaj | Received 27 June 2021 | Accepted 17 September 2021 | Published 25 March 2022

http://zoobank.org/6437C907-FB47-45D5-8A09-BECAB97DFB60

Citation: Steege V, Engelbart D, Hädicke NT, Schäfer K, Wey JK (2022) Germany's federal waterways – A linear infrastructure network for nature and transport. In: Santos S, Grilo C, Shilling F, Bhardwaj M, Papp CR (Eds) Linear Infrastructure Networks with Ecological Solutions. Nature Conservation 47: 15–33. https://doi.org/10.3897/natureconservation.47.70732

Abstract

Major rivers are unique linear structures because they serve different purposes simultaneously: A habitat and dispersal route for flora and fauna as well as a navigation route, the site for recreational and economic activities and a source for drinking water and irrigation. In recent years, it has become increasingly clear that waterways must be developed in an environmentally and economically sustainable and socially responsible manner. The Federal Ministry of Transport and Digital Infrastructure (BMVI) and its specialised agencies – the Waterways and Shipping Administration of the German Federal Government (WSV), the Federal Institute of Hydrology (BfG) and the Federal Waterways Engineering and Research Institute (BAW) – are aiming to achieve this goal by integrating environmental issues into the development and maintenance of waterways. This paper aims to fill the gap on the one hand between scientific analyses of ecological freshwater status and proposals for its improvement, and, on the other hand, bringing this knowledge into practical realisation. Recent activities at the German federal waterways are exemplarily reviewed on the basis of applied research projects, local projects, political programmes and progressive legislation.

Keywords

Biodiversity, bioengineering, Germany's Blue Belt, German waterways, river restoration, Water Framework Directive

Copyright *Volker Steege et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Major rivers are unique linear structures because they serve different purposes simultaneously: Habitat and dispersal route for flora and fauna as well as navigation route, site for recreational and economic activities and source for drinking water and irrigation (Fig. 1). They link up cities and ports. The energy of their running water is used to generate power.

People have travelled on and used rivers to transport goods for thousands of years. For a diversity of reasons, including safety, they also began very early to alter the natural course of flowing water and, over time, built the engineering features which they considered necessary and desirable. Bogs and marshes were drained and reclaimed, weirs and dams were constructed, rivers and streams diked and straightened. The result is an ecological status of rivers and floodplains, which is not satisfactory from our current perspective.

Nature and its vital contributions to people, providing biodiversity and ecosystem functions and services, are deteriorating worldwide. Regarding freshwater ecosystems, this is stated on a global scale currently e. g. by IPBES (2019), Van Rees et al. (2020) and Vari et al. (2021). How to improve this status on a global scale is subject to intense scientific and political discussion within the Post-2020 Global Biodiversity Framework (https://www.cbd.int).

An overview of the ecological status of Europe's waters and wetlands and EU policies aiming to improve water quality is documented by EEA (2019). 40% of Europe's surface water bodies achieve good ecological status based on an assessment of the second river basin management plans (published 2015) required under the EC Water Framework Directive (WFD). Enhanced activities of EU member states are recommended to reach the quality goals of WFD until the timeline 2027.

Figure 1. River Rhine near Maxau (Source: BAW).

On the same data base (WFD, second cycle) in Germany just about 7% of streams and rivers were in at least "good" ecological condition in 2015 (UBA 2021). An assessment of the current state of floodplains on behalf of the Federal Agency for Nature Conservation (BfN) shows that, overall, just under 1% of recent (floodable) river floodplains are very slightly modified (floodplain condition class 1) and 8% are slightly modified (floodplain condition class 2) and thus still largely ecologically functional. 33% of the floodplains are assigned to floodplain condition class 3 (significantly altered), but still have "floodplain character," i.e. the flooding potential still exists, but is limited by alterations to the watercourse. The predominance of floodplain condition classes 4 (heavily modified) and 5 (very heavily modified) at 32% and 26%, respectively, reflects the intensive use of riverine landscapes. However, due to the historically evolved situation of the floodplains as centres of settlement and economic development along the rivers, these changes are only partially reversible (BMU & BfN 2021).

Consequently, today we know that our waterways must be developed in an environmentally and economically sustainable and socially responsible manner. The great challenge now is to establish a balance between transport systems and nature. How can all these functions be integrated with as little conflict as possible?

A scientific overview on knowledge and possibilities to put expertise on river functioning, river management and rehabilitation into practice is given by Buijse et al. (2005). They recommend river rehabilitation to be part of integrated river management to search for win-win options as well as to find compromises where conflicts with other functions arise. Van Rees et al. (2020) conclude that policies and strategies must have a greater focus on the unique ecology of freshwater life and its multiple threats and should reflect on how this may be achieved.

This paper aims to fill the gap on the one hand between scientific analyses of ecological freshwater status and proposals for its improvement, and on the other hand bringing this knowledge into practical realization. The paper documents how the German Federal Ministry of Transport and Digital Infrastructure (BMVI) and its specialised agencies – the Waterways and Shipping Administration of the German Federal Government (WSV), the Federal Institute of Hydrology (BfG) and the Federal Waterways Engineering and Research Institute (BAW) – are aiming to achieve this goal by integrating environmental issues into the development and maintenance of waterways. This happens on the basis of political programmes, progressive legislation, applied research projects and local projects. Building fish passes, creating bypasses in floodplains, riverbank restoration (where possible), and the development of innovative groynes as well as training walls are some practical examples under the umbrella of the so-called "building with nature" approach.

Short overview of the German federal waterways and their connecting function within the national and European biotope network

Fig. 2. gives an overview of the system of German federal waterways within the Central European network of waterways. It is a network that connects the transport of goods and people not only within Germany, but also with neighbouring countries and

Figure 2. Overview of the system of German federal waterways within the Central European waterways network (Source: WSV).

overseas. The volume of goods transported on German inland waterways amounts to about 220 million tons per year. This is currently about 11% of the cargo in the modal split; the remaining large majority is transported by rail and road. The network of federal waterways in Germany comprises about 7,300 kilometres of inland waterways, of which rivers account for about 75 percent of the route and canals for the other 25 percent. The federal waterways also include about 23,000 square kilometres of sea waterways (https://www.gdws.wsv.bund.de/DE/wasserstrassen/wasserstrassen-node.html). Almost all major rivers in Germany serve as waterways.

At the same time, the major German rivers are of course also central connecting axes of the nationwide and the European biotope network (Fig. 3).

Today, it is generally expected that there should be a balance between transport functions of the German federal waterways and consideration of contemporary ecological standards. This expectation has also altered the way in which those in business and administration look at this issue and understand their own roles. Many things which seemed unthinkable just a short time ago are now firmly established in practice and planning. Improving the ecological status of federal waterways is a process which

Figure 3. Connecting axes of the German (rivers: blue lines) and the European (coloured arrows) biotope network (Source: BfN 2016).

always calls for a fine sense of judgement as well as cautiously testing the ground in the search for the possible, followed by reflective assessment of what is subsequently achieved. Important general ecological framework conditions are the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD) and the Birds and Habitats Directives of the EU.

Practical examples of ecological measures and research projects on German federal waterways

Alternative concepts for the protection of river banks

In 2004, the Federal Institute of Hydrology (BfG) and the Federal Waterways Engineering and Research Institute (BAW) launched a joint research programme on the technical and ecological suitability of alternative concepts for the protection of river banks (Schmitt et al. 2018). Studies of hydraulic loads and the ecological potential of this type of construction, taking into account the impact of navigation, are being undertaken along selected stretches of waterways. At the same time, researchers are performing in-depth laboratory studies as well as model studies. Close cooperation between various departments of the BAW (earthworks and bank protection, navigation) and the BfG (landscape conservation, vegetation science, animal ecology) enables interdisciplinary project work from a technical and ecological point of view. Currently, this research has been extended to the waterways at German North Sea estuaries (Fig. 4).

Various biotechnical approaches to bank protection at inland waterways are currently being tested in cooperation with the Oberrhein Waterways and Shipping Office in a large-scale trial on a one kilometre long river section on the right bank of the Rhine near Worms (km 440.6 to km 441.6), i.e. on the largest and busiest waterway in Germany. In the study area, around 120 freight ships per day are operating. Depending on the discharge, the water level fluctuates by over 6 m. The embankments are also relatively steeply inclined. In four test fields, the stone embankments above the mean water level were replaced by willow spreaders, pre-cultivated reed gabions and plant mats or stone mattresses. In another four fields, the stone fill was preserved and ecologically upgraded by various measures. The bank was planted with grazing poles and machines, with bushes and hedges, the bank structure was improved with gravel, large individual stones and deadwood; in addition, protected areas were created by a bank stabilisation of stones in front of the embankment. For comparison, one test field remained without protection (Schilling et al. 2013).

The results of research and best practise examples are presented on the internet: https://ufersicherung.baw.de. The aim of this project is to develop recommendations and basic principles to facilitate an application of the newly-developed methods for bank protection of inland waterways (Söhngen et al. 2018).

Figure 4. Biotechnical approaches to bank protection at German North Sea estuaries (Source: BAW).

Rees flood spillway

Another example of successful and integrated planning, with the early involvement and inclusion of stakeholders, is the flood spillway project near the city of Rees on the lower Rhine (Fig. 5, WSV 2012; BUND 2013). Since the purpose of this federal project is to provide flood protection in addition to preventing erosion of the river bed, it is also co-financed by the state of North Rhine-Westphalia. The Rees flood spillway helps to counteract the lowering of the groundwater level and improves the habitats for wetland fauna and flora. New shallow water and mud areas enliven the wetland fauna. As a result, the species diversity of grassland birds in the floodplain landscape can increase again. The project has gained recognition at European level and has been included in the EC Guidance Document on Inland Waterway Transport and Natura 2000 (EC 2018). In 2014 the bypass on the Rhine was awarded the "Working with nature Award" at the 33rd PIANC (World Association for Waterborne Transport Infrastructure) World Congress (PIANC 2014).

Figure 5. Rees flood spillway (Source: BAW).

Paving the way for migratory fish

In Germany, the WFD was primarily transposed into national law by the Federal Water Act (WHG) and taken up in the laws of the Federal States. With the 2010 amendment to the Federal Water Act, the WSV has taken over responsibility for maintaining and restoring ecological patency at the dams it constructs or operates on federal waterways.

220 weirs in the federal waterways require measures, i.e. structures must be newly constructed or repaired to enable accessibility for fish and macrozoobenthos in order to reach the goals of the WFD. This requires resources to the order of (a currently-estimated) 1 billion euros. In addition, regionally varying management responsibilities need to be coordinated and a variety of economic, ecological and political requirements need to be taken into account. For example, the sometimes complex and technically demanding integration of new fishways into existing structures makes it difficult to implement measures in a timely manner and may lead to conflicts with other objectives (of utilisation) such as energy production by hydropower plants. In addition to the co-ordination of different interests, the planning processes themselves can be lengthy. At the same time, however, the WFD's timeframe for achieving the objectives is tight. For this reason, synergies with already-planned measures (such as the restoration or replacement of defective weirs) are increasingly sought in the implementation of the measures.

Another challenge is the great need, especially for fishways on large water bodies, to close gaps in our knowledge of fish behaviour in relation to topography, geometry and hydraulics in the access area and within ladders in order to be able to guarantee sufficient functionality of the new facilities. A pilot project for monitoring and research is the Mosel fishway near Koblenz (Fig. 6). The successful cooperation between the WSV

Figure 6. Mosel fishway near Koblenz (Source: BfG).

and the state of Rhineland-Palatinate was crowned by the opening of the modern fishway in September 2011. In March 2012, the first upstream-migrating salmon was registered and in July 2013 a shad was seen for the first time in 60 years to ascend the river Mosel. All in all, the fishway has proven to be passable for most fish species and sizes, leading to notably high yearly numbers of ascending fish (e.g. more than 230.000 in 2015 (BfG 2017)). The state of Rhineland-Palatinate has moreover built a visitor centre, the "Mosellum", where visitors can immerse themselves in the world of migratory fish.

To approach all the aforementioned challenges, an implementation strategy, which takes into account different ecological and economic requirements, reflecting political and administrative boundaries and providing a strategy for closing knowledge gaps through research projects, was developed at the federal level (BMVBS 2012; BMVI 2015; BfG & BAW 2017). The prioritisation for the implementation of measures (BMVI 2015) is currently updated and will be integrated into Germany's management plans for the third implementation cycle of the WFD.

Synergies between different actors

These examples are only a small selection from the wide range of measures with which the WSV in Germany contributes to the preservation and promotion of biodiversity on watercourses as linear landscape structures within the framework of maintaining the waterways, but also in the course of compensation measures for expansion projects and in the fulfilment of legal obligations.

However, the fulfilment of legal tasks is only one side of the coin for achieving water-ecological objectives. If someone wins one hundred percent (e.g. nature conservation) there are usually also losers (often e.g. agricultural land). In our participatory and federal society, there is no progress in the implementation of measures on waterways without taking into account the users and social groups as well as institutions concerned. For this reason, the BMVI together with the WSV are increasingly focusing on dialogue and communication and integrated project planning, e.g. LIFE projects, funded by the EU.

LIFE+ project "My favourite river" Zugwiesen

A new floodplain has been created from 2011–2013 along the river Neckar near Stuttgart: the "Zugwiesen". The "Zugwiesen" project became the responsibility of several stakeholders, who normally have different fields of activity and whose interests are occasionally in conflict. The WSV, on the one hand, is responsible for the river Neckar and its utilisation as a traffic route; the city of Ludwigsburg, on the other hand, has responsibility for the larger river bank areas. Both sides put forward convincing arguments and showed creativity which resulted in a joint concept. As the concrete slabs on the left Neckar embankment exhibited considerable damage, the Waterways and Shipping Office Stuttgart decided to integrate reconstruction works into the ecological redevelopment of the "Zugwiesen" floodplain. The embankment was levelled over a length of 800 metres. The former wall was removed, the river and the floodplain were reunited (Fig. 7).

Figure 7. LIFE+ project "My favourite river" Zugwiesen (Source: Jochen Faber, INFO & IDEE GmbH).

The Zugwiesen-project clearly shows that the banks of a river can offer exemplary habitat conditions, even if there is high traffic from ships. Diverse habitats for plants and animals invite visitors to observe and learn while getting some fresh air. Federal and local government have engaged in an unprecedented level of cooperation to realise the project. The new "Zugwiesen" floodplain covers an area of 17 hectares and includes a new water body with an area of 40,000 sqm. The former bank reinforcement was broken up and vegetation planted for a near-natural bank protection, resulting in the restoration of the entire large area along the Neckar bend. Meadows, an alluvial forest with willow and alder trees, still-water bodies with islands, wetlands and ponds as well as a brook winding its way through the area provide a habitat for animals and plants. An observation platform, the "Stork's Nest" enables visitors to observe even those protected parts of the area that are not allowed to enter (https://neckar.ludwigsburg.de/start/Projekte/Zugwiesen.html).

Integrated EU-LIFE-project "Living Lahn"

Some minor waterways in Germany are no longer used for the transport of goods as they had been before. For some of these waterways, development strategies to reduce infrastructures that are no longer required and the enhancement of opportunities for ecological development and recreational activities are discussed. The integrated European Union's LIFE-project "Living Lahn - one river, many interests" (2015–2025), conducted by the federal state of Hesse together with the federal state of Rhineland-Palatinate, the WSV and the BfG aims at helping to restore the "good ecological potential" of the federal waterway Lahn. At the same time, the interests of shipping and other competing uses will be integrated in accordance with ecological requirements. This project creates best-practice examples for other rivers. "Living Lahn" was the first integrated LIFE-project, which has been funded in Germany by the European Commission (HMUKLV 2021) (https://www.lila-livinglahn.de/en/start).

The project partners are:

- Hessian Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection;
- Ministry for Climate Protection, Environment, Energy and Mobility of Rhineland-Palatinate;
- Directorate for Infrastructure and Approval North;
- Governmental Authority of Gießen;
- Waterways and Shipping Office Mosel-Saar-Lahn;
- German Federal Institute of Hydrology.

The first main objective of the Living Lahn project is to enhance the ecological status and connectivity of the river itself while simultaneously enriching the quality of life along the river. This aim will be reached through practical projects such as

- Restoration of natural retention areas and their self-regulation.
- Identification of pollution sources and their elimination in order to improve the water quality.
- Improving structural diversity in weir-regulated river stretches.
- Implementation of measures for restoring the linear patency in different types of locks and weirs, thus leading to a direct improvement of the water-bound habitats and their different animal and plant species.
- Promotion of sustainable tourism offers e.g. in the field of canoeing/rowing by constructing new portage sites as well as by providing a "Lahn App" for better planning of leisure activities.

The second main objective is to develop an overall concept, the so-called "Lahn-Concept", which takes into account its further ongoing use as a federal waterway as well as water ecology and revitalisation aspects and flood protection. Ever since 1981, the Lahn has no longer been used for freight transport. The weir buildings partly need substantial restoration and maintenance works, calling for urgent action from the responsible authorities.

The Lahn-Concept pursues a holistic approach, in order to integrate the numerous interests, usages, and stakeholders, and, of course, the Lahn River itself, into the development process. With the participation of all project partners and the interested public, the Lahn-Concept offers a unique opportunity to 're-invent' the technical maintenance of the Lahn, to enhance the ecological health and connectivity of the river itself, to improve the potential for tourists, to implement the goals of the Water Framework Directive and to consider further relevant correlations. The challenge will be to balance competing interests as there are flood protection, nature conservation, shipping, water conservation, economic efficiency, hydropower, tourism, agriculture, fisheries, and more.

For this purpose, the responsible project partner Waterways and Shipping Office Mosel-Saar-Lahn involved the public in a dialogue process at an early stage. Transparency and acceptance among the population will be fostered by regular publications, working groups and workshops, wherever necessary in order to collect feedback from relevant stakeholders.

The question of retaining or tearing down weirs to reach different objectives is often at the heart of the discussion process. As a way to rationalize discussions (and, possibly, decisions) concerning this topic, a study was set up to examine the effects of the removal of selected weirs on ecosystem services (ES). In this study, which is in its final stage, the RESI (River Ecosystem Services Index, Podschun et al. 2018) approach is utilised. The case study has already been used to refine parts of the ES concept (Albert et al. 2020). Moreover, the BMVI is currently discussing the use of certain ecosystem services indicators for future decision processes concerning traffic projects.

The WSV is responsible for approx. 2,800 km of secondary waterways. They have lost their importance for freight traffic due to changing transport flows and ship sizes and are now mainly used for tourism. Thus, it will be a key issue to elaborate concepts and perspectives in order to face challenges arising from the development described above. The common elaboration of the Lahn-Concept is considered a pilot activity for the WSV and can serve as a blueprint for further sustainable development concepts of other federal waterways of the same category.

Overall concept Elbe (Gesamtkonzept Elbe)

In the past, various demands for use of the Elbe River, such as shipping, nature conservation, flood protection, tourism and port management, have led to controversial disputes between the actors involved. The Binnenelbe upstream from the weir Geesthacht is home to valuable natural and cultural landscapes as well as original habitats of outstanding importance. The Elbe River landscape is a model landscape for sustainable development of the United Nations on more than 400 kilometres of the river as the oldest German UNESCO-biosphere reserve (https://www.flusslandschaft-elbe.de/start/?changelang=2).

Against the background of the different utilisation claims with legal obligations and the transferred responsibilities, the German Federal Ministry of Transport and Digital Infrastructure (BMVI) together with the Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), agreed at the federal level at the end of 2010 on a paper of key issues for an overall concept for the Elbe. In subsequent years, the overall concept Elbe (Fig. 8) was consolidated and institutionalised in a broad dialogue with federal states and various stakeholders in numerous conferences and consultations. Today, it has rules of procedure and bodies for cooperation at steering and working level. It forms the foundation for the long-term development of the Elbe upstream of Geesthacht, both as a shipping route and as a valuable natural area, taking into account other interests of use (https://www.gesamtkonzept-elbe.bund.de/Webs/GkElbe/DE/Home/home_node.html).

Figure 8. Overall concept Elbe (Gesamtkonzept Elbe) (Source WSV).

The overarching objectives are to combat erosion, improve flood protection, reduce inputs of contaminants, improve shipping conditions and maintain and restore habitats and habitat types in waters, banks and floodplains.

The implementation of the overall concept is not the sole responsibility of the German federal government. The federal states also have some essential responsibilities - such as flood protection as part of water management, nature conservation, tourism and port management. In its course and with its tributaries, the Elbe River touches ten of Germany's 16 federal states. This is a task for the next decades.

Germany's Blue Belt and new legislation

"Germany's Blue Belt" is one of the BMVI's new flagships. It is a Federal Government programme in cooperation with the BMU. After the initial impulse from the coalition agreement of the Federal Government in 2013, and some years of political activities and conceptual preparatory work, the operational phase of the „Blue Belt" programme started in 2019 (https://www.blaues-band.bund.de/Projektseiten/Blaues_Band/DE/neu_01_Bundesprogramm/bundesprogramm_node.html). It aims at developing a system of interlinked biotopes of national significance along Germany's federal waterways within the next decades and provides an opportunity to link adapted infrastructure standards to ecological objectives. This will also help to make these regions more attractive for leisure and recreational activities.

One important part of the implementation is the Federal Floodplain Programme which is managed by the Federal Agency for Nature Conservation (BfN). Measures strengthening lateral connectivity between rivers and floodplains are of special significance within the programme. In parallel, the objectives of the WFD and the Natura 2000 Directives are supported.

"Germany's Blue Belt" establishes a framework for action over the coming decades. Although it focuses on the network of minor waterways, it also defines "ecological stepping stones" for the very busy federal waterways. Such renaturalisation measures may include the reconnection of abandoned meanders and flood channels or the levelling of banks, provided that this is also compatible with the transport of freight. However, if rivers, banks and floodplains are developed as a holistic entity, also areas will be affected that are not owned by the Federal Government. Here, a financial-assistance programme of BfN creates incentives for supporting the restoration of habitats typically found on floodplains. The budget of the Federal Ministry for the Environment for 2020 e.g. provides 6.8 million euros for the Floodplain Programme. For the years 2021 to 2023 there are commitment appropriations of around 25 million euros (https://www.bfn.de/blauesband/foerderprogramm-auen.html).

Most of the watercourses in question, namely the federal waterways, are owned by the German Federal Government. It is thus a good idea to task the WSV with implementation of this programme, especially as it already has the necessary expertise and experience.

In 2016, the Federal Waterways Administration launched five model-projects (BMVI & BMU 2020) (https://www.blaues-band.bund.de/Projektseiten/Blaues_Band/DE/neu_04_Projekte/Aktuelle_Projekte/Projekte_node.html).

One model-project, the bank renaturation "Kühkopf-Knoblochsaue" on the river Rhine (Fig. 9), was hailed as a successful example as part of the UN Decade of Biological Diversity in 2020.

While launching the Blue Belt programme, it quickly became clear that the existing legal obligations of the WSV were not sufficient to carry out major renaturation measures that are to be classified as water management expansion. To enable the WSV to manage all these tasks in an appropriate manner, the BMVI and the BMU pursued an extension of legal tasks to allow the WSV to support the goals of the WFD to an extended degree. A corresponding amendment to the law was prepared by the German Federal Government in coordination with the Water Management Administration of the Federal States. On 09 June 2021, the new law came into force. The Federal Waterways Administration is now given the sovereign task of implementing water management expansion measures to achieve the hydromorphological objectives of the WFD. This kills two birds with one stone: the implementation of Germany's Blue Belt will be fully enabled administratively and the WSV can contribute actively to the achievement of the WFD objectives. This new legal task for the WSV will significantly advance and help to accelerate the implementation of the WFD on German federal waterways in the upcoming years and decades.

Figure 9. Germany's Blue Belt model project "Kühkopf-Knoblochsaue", River Rhine km 474.0–476.5.

Conclusion and perspectives, monitoring

The examples given in this overview illustrate how the German Federal Ministry of Transport and Digital Infrastructure (BMVI) and its specialised agencies are aiming to achieve the goal of integrating environmental issues into the development and maintenance of waterways. Important triggers for this process have been the EU environmental directives, where a starting point was the Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment.

As a result of many years of efforts to improve the performance of WSV for the ecological development of rivers used as federal waterways, the following key factors can be highlighted for successful implementation:

1. Support for this expansion of tasks by political decision makers and NGO's;
2. Contributions to the achievement of environmental goals as statutory responsibility (→ legal responsibility for ecological patency and hydromorphological measures to reach the objectives of the WFD in federal waterways);
3. Organisational units and staff for environmental tasks (→ new environmental division within the waterways administration, > 100 new employees within the last years);
4. Allocation of budgetary funds (→ still insufficient; helpful funding by EU (LIFE-projects Lahn, Neckar) and by BMVI and BMU (Germany's Blue Belt));
5. Cooperation projects between waterways administration and environmental authorities at national, federal and local levels as well as cooperation agreements with NGO's (→ Germany's Blue Belt, LIFE-projects, Overall concept Elbe);
6. Organisational consolidation of the forms of cooperation over many years (→ Germany's Blue Belt, Lahn concept, Overall concept Elbe);
7. Land availability (→ Prerequisite for all renaturation measures in the riparian area and in the floodplains);
8. Continuous input of scientific expertise, consulting and monitoring (→ by specialised BMVI agencies BfG, BAW);
9. Visibility (→ Public relations and combination with nature leisure experience) – closes the loop to policies (1.).

The implementation of these measures on the German waterways will be accompanied and documented in the long term by monitoring, where the BfG will have a special task. Since an improvement in the ecological status/potential of water bodies or the floodplain status in larger spatial units cannot be expected within a few years, it is important to highlight the special value of even small-scale measures accordingly and to make them visible to the public. The following rather general aspects should here be emphasised:

- aim for measures that are as effective as possible;
- bring together several partners and causes to large-scale projects (e.g. link compensation measures with renaturation measures or ecological flood protection measures, use of eco-accounts);

- bring ecosystem services more into focus as part of cost-benefit considerations (Pusch et al. 2018; Hornung et al. 2019; Funk et al. 2020);
- implementation of integrated management plans (Navigation, sediment management, WFD, MSFD, Natura 2000, Floods Directive 2007/60/EC).

Closing remarks

Integrating ecological objectives more strongly into administrative action is an ongoing but crucial process which will last several decades. Planning processes and realisation of projects – including projects for nature conservation – require a great deal of time and coordination due to diverse legal requirements and social demands, interdependencies and trade-offs. Nevertheless, more integrated planning is necessary. For this purpose, however, appropriate and substantial resources are needed – money, staff, and time. Another key bottleneck, especially for larger projects, is the availability of suitable areas. Managing land tenure is difficult and time-consuming. Hence, in our densely-populated region of Central Europe it will not be able to achieve all ambitious environmental goals at large rivers within a few years. Following these goals through a long-term perspective therefore requires a certain amount of patience and endurance. BMVI, together with the WSV, are nevertheless en route to achieve these goals.

References

Albert C, Brenner J, Hermes J, Metzger D, Thiele J (2020) Assessing the Uniqueness of River Landscapes: The Lahn Case Study. In: Wang F, Prominski (Eds) Water-Related Urbanization and Locality. Springer, Singapore, 303–315. https://doi.org/10.1007/978-981-15-3507-9_16

BfG (2017) BfG registriert an Fischaufstiegsanlage Koblenz über 230.000 aufsteigende Fische. Press release by the Federal Institute of Hydrology, Koblenz. https://www.bafg.de/DE/Service/presse/2017_04_07_pm.pdf?__blob=publicationFile

BfG & BAW (2017) Herstellung der ökologischen Durchgängigkeit für Fische an den Staustufen der Bundeswasserstraßen. Rahmenkonzept für Forschung und Entwicklung. Bundesanstalt für Gewässerkunde, Koblenz & Bundesanstalt für Wasserbau, Karlsruhe. https://www.bafg.de/DE/02_Aufgaben/03_Oekologie/02_Themen/Durchg/rk_fe.html?nn=174410

BfN (2016) Grenzüberschreitender Biotopverbund - Handlungsansätze und Herausforderungen für Planung und Naturschutzpraxis. Schriftenreihe Naturschutz und Biologische Vielfalt, Heft 146, 148 pp. https://www.bfn.de/fileadmin/BfN/landschaftsundbiotopschutz/Dokumente/BV_International_2014.pdf

BMU & BfN (2021) Auenzustandsbericht 2021. Flussauen in Deutschland. Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit, Bonn & Bundesamt für Naturschutz, Bonn. https://www.bfn.de/fileadmin/BfN/wasser/Dokumente/AZB_2021/AZB_2021_bf.pdf

BMVBS (2012) Erhaltung und Wiederherstellung der ökologischen Durchgängigkeit der Bundeswasserstraßen. Erläuterungsbericht zu Handlungskonzeption und Priorisierungskonzept des BMVBS. Bundesministerium für Verkehr, Bau und Stadtentwicklung, Bonn. https://www.bafg.de/DE/02_Aufgaben/03_Oekologie/02_Themen/Durchg/prio_konzept.pdf?__blob=publicationFile

BMVI (2015) Erhaltung und Wiederherstellung der ökologischen Durchgängigkeit der Bundeswasserstraßen. Bundesweites Priorisierungskonzept und Maßnahmen-priorisierung für den Fischaufstieg – 1. Fortschrittsbericht. Bundesministerium für Verkehr und digitale Infrastruktur, Bonn. https://www.bafg.de/DE/02_Aufgaben/03_Oekologie/02_Themen/Durchg/fortschr1_prio_konzept.pdf?__blob=publicationFile

BMVI & BMU (2020) Bundesprogramm „Blaues Band Deutschland" - Modellprojekte als ökologische Trittsteine an den Bundeswasserstraßen. Bundesministerium für Verkehr und digitale Infrastruktur & Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit, Bonn. https://www.blaues-band.bund.de/Projektseiten/Blaues_Band/DE/SharedDocs/Downloads/BBD_Modellprojekte.pdf?__blob=publicationFile&v=6

Buijse AD, Klijn F, Leuven RSEW, Middelkoop H, Schiemer F, Thorp JH, Wolfert HP (2005) Rehabilitation of large rivers: References, achievements and integration into river management. Arch. Hydrobiol. Suppl. 155(1–4): 715–738. https://doi.org/10.1127/lr/15/2003/715

BUND (2013) Naturverträgliche Bau- und Unterhaltungskonzepte an Bundeswasserstraßen. Studie im Auftrag des Bund für Umwelt und Naturschutz Deutschland e.V. (BUND), Berlin: 40–44. https://www.bund.net/fileadmin/user_upload_bund/_migrated/publications/20130322_bund_wasser_lebendige_fluesse_bundeswasserstrassen_studie.pdf

EC (2018) European Comission: Guidance on Inland waterway transport and Natura 2000: 40–41. https://ec.europa.eu/environment/nature/natura2000/management/docs/iwt_en.pdf

EEA (2019) The European environment – state and outlook 2020. Knowledge for transition to a sustainable Europe. European Environment Agency. Publications Office of the European Union, Luxembourg. https://www.eea.europa.eu/publications/soer-2020/at_download/file

Funk A, Tschikof M, Grüner B, Böck K, Hein T, Bondar-Kunze E (2020) Analysing the potential to restore the multi-functionality of floodplain systems by considering ecosystem service quality, quantity and trade-offs. River Research and Applications 2021(37): 221–232. https://doi.org/10.1002/rra.3662

HMUKLV (2021) Broschüre Lebendige Lahn – Ein Fluss, viele Interessen, Halbzeitbilanz. Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz, Geschäftsstelle LiLa Living Lahn, Wiesbaden, 14 pp. https://www.lila-livinglahn.de/fileadmin/files/lila/public/Broschueren/201001LiLa-Lahn_Broschuere_komplett.pdf

Hornung LK, Podschun SA, Pusch M (2019) Linking ecosystem services and measures in river and floodplain management. Ecosystems and People 15(1): 214–231. https://doi.org/10.1080/26395916.2019.1656287

IPBES (2019) Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES secretariat, Bonn, 1144 pp.

PIANC (2014) Booklet "Working with nature award 2014" – Collection of Waterborne Infrastructure Projects, Acknowledged by PIANC. https://www.pianc.org/uploads/files/EnviCom/WwN/WwN-Booklet.pdf

Podschun S, Thiele J, Dehnhard A, Mehl D, Hoffmann T, Albert C, Haaren C, Deutschmann K, Fischer-Bedtke C, Scholz M, Costea G, Pusch M (2018) The ecosystem service concept - A chance for integrative water resource management. Hydrologie und Wasserbewirtschaftung 62: 453–468. https://doi.org/10.5675/HyWa_2018.6_7

Pusch MT, Podschun SA, Coste G, Gelhaus M, Stammel B (2018) With RESI towards a more integrative management of large rivers and floodplains. Danube News 38(20): 6–10.

Schilling K, Kleinwächter M, Liebenstein H (2013) Technical-biological river bank protection – a contribution to the ecological improvement of the banks of Federal waterways in Germany – First experiences from a field test along the River Rhine. PIANC -SMART Rivers Conference, 23.–27. September 2013, Maastricht/Liège. https://izw.baw.de/publikationen/alu/0/20130924_PIANC_full-paper_Schilling.pdf

Schmitt K, Schäffer M, Koop J, Symmank L (2018) River bank stabilisation by bioengeneering: potentials for ecological diversity. Journal of Applied Water Engineering and Research. https://doi.org/10.1080/23249676.2018.1466735

Söhngen B, Fleischer P, Liebenstein H (2018) German guidelines for designing alternative bank protection measures. Journal of Applied Water Engineering and Research 6(4): 298–305. https://doi.org/10.1080/23249676.2018.1514281

UBA (2021) Daten zur Umwelt – Umweltmonitor 2020. Umweltbundesamt Dessau-Roßlau, Germany, 115 pp. https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/daten-zur-umwelt_umweltmonitor-2020_webfassung_bf.pdf

Van Rees CB, Waylen KA, Schmidt-Kloiber A, Thackeray SJ, Kalinkat G, Martens K, Domisch S, Lillebø AI, Hermoso V, Grossart H-P, Schinegger R, Decleer K, Adriaens T, Denys L, Jarić I, Janse JH, Monaghan MT, De Wever A, Geijzendorffer I, Adamescu MC, Jähnig SC (2020) Safeguarding freshwater life beyond 2020: Recommendations for the new global biodiversity framework from the European experience. Conservation Letters 14(1): e12771. https://doi.org/10.1111/conl.12771

Vari A, Podschun SA, Erös T, Hein T, Pataki B, Ioja IC, Adamescu CM, Gerhardt A, Gruber T, Dedic A, Ciric M, Gavrilovic B, Baldi A (2021) (2021) Freshwater systems and ecosystem services: Challenges and chances for cross-fertilization of disciplines. Ambio. https://doi.org/10.1007/s13280-021-01556-4

WSV (2012) Die Flutmulde Rees, 2nd edn., Wasser- und Schifffahrtsamt Duisburg-Rhein. https://docplayer.org/24876385-Wir-machen-schifffahrt-moeglich-die-flutmulde-rees.html